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Journal of the Society of Arts.

FRIDAY, JUNE 1, 1855.

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TRADE MUSEUM.

A few gentlemen interested in the application of Science to Arts and Manufactures, intend meeting at the Society's house on Tuesday evening next, the 5th of June, at eight o'clock, to examine the Trade Museum, recently formed under the joint authority of Her Majesty's Commissioners for the Exhibition of 1851 and the Society of Arts, when members of the Society are invited to attend.

FOURTH ANNUAL CONFERENCE AND 101st ANNIVERSARY DINNER.

The Council beg to announce that the Fourth Annual Conference of the Representatives of the Institutions in Union, will be held on Monday, the 2nd of July, at 11 a.m. precisely. Also that the One Hundred and First Anniversary Dinner will take place on Tuesday, the 3rd of July.

Further particulars will be published next week.

TWENTY-FOURTH ORDINARY MEETING.

Wednesday, May 30, 1855.

The Twenty-fourth Ordinary Meeting of the One Hundred and First Session, was held on Wednesday, the 30th inst., the Rev. Dr. Booth, F.R.S., Member of Council, in the chair.

The following Candidates were balloted for and duly elected :—

Crosbie, Arthur
Hardwicke, Earl of
Isaac, John Raphael
Kennedy, Colonel John Pitt

The following Institution has been taken into Union since the last announcement :—

395. Bolton, Church Educational Institution.

Previous to the reading of the paper, the Secretary called attention to a specimen of Holmes' Patent Tyre. This tyre has a narrow rib of iron upon the centre of a flat bar, by which the friction on the ground is said to be reduced, whilst it is more durable and lighter, and has all the advantages of a wide tyre upon soft ground.

The paper read was

ON EARTH-BORING MACHINERY.

By Colin Mather.

The object of the present paper is to describe the various modes of boring artesian wells, or, in other words, of earth-boring, which has become a matter of considerable importance in relation to several objects of public utility and of private enterprise.

When the country was thinly inhabited, the water supplied by surface springs and rivers was found sufficient for the ordinary wants of human life ; but when population increased, and the land came more into cultivation, the supply decreased as the demand increased, and it was found necessary to obtain additional supplies of water by digging artificial wells. In course of time, as manufacturing processes were developed, and large cities grew up, other resources had to be created. Among various plans which might be mentioned, the formation of artesian wells has been resorted to in modern times, and with considerable success.

In the sinking of wells, and especially wells of this description, improvements in the art of boring become peculiarly interesting and valuable.

Among the various systems and applications which have been adopted, one well-known method of boring is to attach the chisel to a series of rods, which are suspended from the end of a spring pole. The workmen, taking their stand at the end of the pole, give the vibratory motion, which raises the rods after a stroke has been given, whilst others turn the bar, causing the chisel to strike upon a fresh place, and so gradually to penetrate the earth. When the debris has accumulated so as to obstruct the progress of the chisel, the rods are withdrawn by means of a windlass, each one being unscrewed as it is wound up; when the last rod is raised, the chisel is detached, and the shell for collecting the debris is substituted; this is then lowered by means of the windlass, one rod after another being screwed on till the shell has reached the bottom.

The shell is a tubular instrument, of sheet iron, usually from three to four feet long, something less in diameter than the size of the hole, with a clack at the bottom. This is plunged into the *debris*, and what HAPPENS to get into the shell and above the clack is then brought to the surface, assuming the clack to close as it is designed to do, by winding and unscrewing as before.

Another method of boring is to give the impulsive motion by means of a windlass, which has a rope coiled a few times round the barrel; one end of the rope is attached to the boring rod, and the other is held by the workman, who draws the rope tight. The windlass being then slightly turned, the friction upon the barrel being sufficient to enable the workman to hold the rope, the rods are raised a sufficient height to give the required stroke. The workman then slacks the rope suddenly, when the coils become loose, and the rods descend with a force equal to the motion derived from their own weight and the distance through which they have to fall. This method is generally resorted to when the weight of the rods is so great as to overcome the elasticity of a spring-pole.

A third method is that described by Mr. Vignoles, in a paper read at a meeting of the British Association, and which appeared in the *Mining Journal* of September 26th, 1846.

Mr. Vignoles says :—" The apparatus is composed of a hollow boring rod, formed of wrought-iron tubes screwed end to end ; the lower end of the hollow rod is armed with a perforating tool, suited to the character of the strata which have to be encountered. The diameter of the tool is larger than the diameter of the tubular rod, in order to form around it an annular space through which the water and the excavated material may rise up. The upper end of the hollow rod is connected with a force-pump by jointed and flexible tubes, which will follow the descending movement of the boring tube for an extent of some yards. This boring tube may be either worked by a rotary movement with a turning handle, or by percussion with a jumper. The frame and tackle for lifting, lowering, and sustaining the boring tube, offer nothing particular. When the boring tube is to be worked, the pump must be first put in motion. Through the interior of the tube a column of water is sent down to the bottom of the bore-hole—which water, rising in the annular space beween the exterior of the hollow boring-rod and the sides of the bore-hole, creates an ascending current which carries up the triturated soil; the boring tube is then worked like an ordinary boring-rod; and as the material is acted upon by the tool at the lower end, it is immediately carried up to the top of the bore-hole by the ascending current of water. It is a consequence of this operation, that the cuttings being constantly carried up by the water, there is no longer any occasion to draw up the boring tube to clear them away—making a very great saving of time. Another important and certainly no less advantage, is, that the boring tools never get clogged by the soil; they work constantly, (without meeting obstructions) through the strata to be penetrated, thus getting rid at once of nine-tenths of the difficulties of boring."

The writer of this paper admits that the wonderful results of this machine, contemplated in the report from which the above extract is taken, caused him at that time to pause in proceeding further with his experiments on earth-boring. After patiently waiting from September, 1846, till May, 1848, without hearing of the method of boring thus favourably described being carried into execution, he wrote the following letter to the editor of the *Mining Journal*:—

"Sir,—I should be extremely obliged if you, or any of your correspondents, would inform me what progress Fauvelle's new system of boring has made in this country. I have been anxiously looking and waiting for some marvellous result ever since your number of the 26th September, 1846. It was also stated in your journal of the 5th December, 1846, that the Pennant Lead and Copper Mining Company had made arrangements to test its capabilities.

"If you could return answers to the following questions it would be deemed a favour by many of your readers and correspondents:—Whether, in the first place, the trial alluded to ever took place, and, if so, what has been the result? Or, if it is still going on, what are the expectations it holds out? And, lastly, the address of the parties who have it in hand.

"Manchester, May 11th."

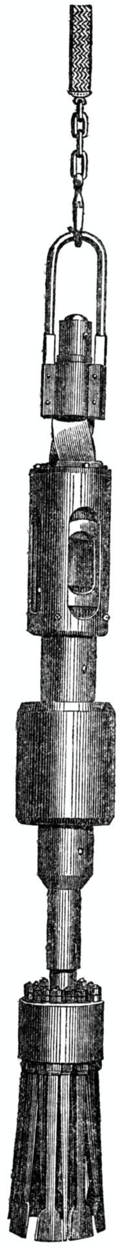
As no answer appeared it was taken for granted that the whole description corresponded with a statement in the same report, "That the weight of a hollow rod, three inches in diameter, and the iron a quarter of an inch thick, would be *less* than that of a solid rod of an inch diameter."

At the present time a well is being bored at Highgate by MM. Degousée, probably the most experienced and extensive borers known. Great praise is due to them for the liberal way in which they publish their proceedings and explain their apparatus. Their method differs but little in principle from that generally used in this country, except in the employment of steam power for raising and lowering the rods, and for giving the percussive motion to the cutters, and, further, in the great variety and superior make of their implements. Perhaps the greatest novelty of their system is that, instead of the spring pole or the windlass, they use a lever, the motion being applied to one end of the lever, and the rods attached to the other. A counterbalance is attached at the motion end of the lever, partly to counterpoise the great weight of the rods.

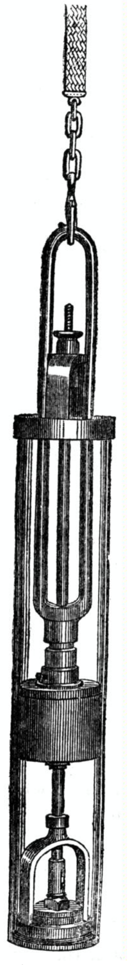
A great deal has been said about the Chinese method of boring with a rope, but sufficient details have never reached this country to enable that method to be carried into practice here.

Having thus briefly described the methods of boring now in general use, it is next proposed to explain the new and improved plan just being brought into operation.

The construction of the boring head and shell pump, and the mode of acquiring the percussive motion, constitute the chief novelties of the system and machine. The couple-cylinder engine, with the reversing or link motion, is used for winding and lowering apparatus, but an ordinary winding engine, similar to those used in collieries, may be applied.



BORING HEAD.



SHELL PUMP.

The boring head consists of a wrought-iron bar, about eight feet long, on the lower part of which is fitted a block of cast iron, in which the chisels or cutters are firmly secured. Above the chisels an iron casting is fixed to the bar, by which the boring-head is kept steady and perpendicular in the hole. A mechanical arrangement is provided, by which the boring-head is compelled to move round a part of a revolution at each stroke. The loop or link by which the boring apparatus is attached to the rope is secured to a loose casting on the wrought-iron bar, with liberty to move up and down about six inches. A part of this casting is of square section, but twisted about one-fourth of the circumference. This twisted part moves through a socket of corresponding form on the upper part of a box, in which is placed a series of ratchets and catches, by which the rotary motion is produced. Two objects are here accomplished—one the rotary motion given to the boring-head, the other a facility for the rope to descend after the boring-head has struck, and so prevent any slack taking place, which would cause the rope to dangle against the side of the hole, and become seriously injured by chafing.

The shell-pump is a cylinder of cast-iron, to the top of which is attached a wrought-iron guide. The cylinder is fitted with a bucket similar to that of a common lifting pump, with an India-rubber valve. At the bottom of the cylinder is a clack, which also acts on the same principle as that in a common lifting-pump, but it is slightly modified to suit the particular purpose to which it is here applied. The bottom clack is not fastened to the cylinder, but works in a frame attached to a rod which passes through the bucket, and through a wrought-iron guide at the top of the cylinder, and is kept in its place by a cotter, which passes through a proper slot at the top of the rod. The pump-rod, or that by which the bucket is worked, is made of a forked form, for the twofold purpose of allowing the rod to which the bottom clack is attached to pass through the bucket, and also to serve as the link or loop by which the whole is suspended.

The wrought-iron guide is secured to the top of the cylinder, and prevents the bucket from being drawn out when the whole is so suspended. The bottom clack also is so arranged that it is at liberty to rise about six inches from its seating, so as to allow large fragments of rock, or other material, to have free access to the interior of the cylinder when a partial vacuum is formed there by the up-stroke of the pump.

The percussive motion is produced by means of a steam cylinder, which is fitted with a piston of 15 inches diameter, having a rod of cast-iron 7 inches square branching off to a fork in which is a pulley of about three feet in diameter, of sufficient breadth for the rope to pass over, and with flanges to keep it in its place. As the boring-head and piston will both fall by their own weight when the steam is shut off, and the exhaust-valve opened, the steam is admitted only at the bottom of the cylinder; the exhaust-port is a few inches higher than the steam-port, so that there is always an elastic cushion of steam of that thickness for the piston to fall upon.

The valves are opened and shut by a self-acting motion derived from the action of the piston itself, and as it is of course necessary that motion should be given to it before such a result can ensue, a small jet of steam is allowed to be constantly blowing into the bottom of the cylinder; this causes the piston to move slowly at first, so as to take up the rope, and allow it to receive the weight of the boring rod by degrees, and without a jerk. An arm which is attached to the piston-rod then comes in contact with a cam, which opens the steam-valve, and the piston moves quickly to the top of the stroke. Another cam, worked by the same arm, then shuts off the steam, and the exhaust-valve is opened by a corresponding arrangement on the other side of the piston rod. By moving the cams the length of the stroke can be varied at the will of the operator, according to the material to be bored through. The fall of the boring-head and piston can also be regulated by a weighted valve on the exhaust-pipe, so as to descend slowly or quickly, as may be required.

The general arrangement of the new machine may be described as follows:—

The winding drum is 10 feet in diameter, and is capable of holding 3000 feet of rope, 4½ inches broad and half an inch thick; from the drum the rope passes under a guide pulley, through a clam and over the pulley which is supported on the fork end of the piston rod, and so to the end which receives the boring head, which being hooked on and lowered to the bottom, the rope is gripped by the clam. A small jet of steam is then turned on, causing the piston to rise slowly until the arm moves the cam, and gives the full charge of steam; an accelerated motion is then given to the piston, raising the boring head the required height, when the steam is shut off, and the exhaust opened in the way described, thus effecting one stroke of the boring head as regulated by a back pressure valve in the exhaust pipe. The exhaust port is six inches from the bottom of the cylinder; when the piston descends to this point it rests on a cushion of steam, which prevents any concussion. To increase the lift of the boring head or compensate for the elasticity of the rope, which is found to be one inch in one hundred feet, it is simply necessary to raise the cams on the cam shaft whilst the percussive motion is in operation. The clam which grips the rope is fixed to a slide and screw, by which means the rope can be given out as required. When this operation is completed, and the strata cut up by a succession of strokes thus effected, the steam is shut off from the percussive cylinder, the rope unclamped, the winding engine put in motion, and the boring head brought up and slung from an overhead suspension bar by a hook fitted with a roller to traverse the bar. The shell-pump is then lowered, the *debris* pumped into it, by lowering and raising the bucket about three times, which the reversing motion of the winding engine readily admits of; it is then brought to the surface and emptied by the following very simple arrangement. At a point in the suspension bar a hook is fixed perpendicularly over a small table in the waste tank, which table is raised and lowered by a screw. The pump being suspended from the hook hangs directly over the table, which is then raised by the screw till it receives the weight of the pump. A cotter, which keeps the clack in its place, is then knocked out, and the table screwed down. The bottom clack and the frame descending with it, the contents of the pump are washed out by the rush of water contained in the pump cylinder. The table is again raised by the screw, and the clack resumes its proper position; the cotter is then driven into the slot, and the pump is again ready to be lowered into the hole as before. It is generally necessary for the pump to descend three times in order to remove all the debris broken up by the boring head at one operation.

The following facts obtained from the use of the machine in boring in the new red sand stone at Manchester, will shew its actual performance, and enable us to compare it with the other systems mentioned in this paper. The boring head is lowered at the rate of 500 feet a minute; the percussive motion is performed at the rate of 24 blows a minute, and being continued for ten minutes, the cutters in that time penetrate from 5 to 6 inches; it is then wound up at 300 feet a minute. The shell pump is then lowered at the rate of 500 feet a minute, the pumping continued for one minute and a half, and being charged, the pump is wound up at 300 feet a minute. It is then emptied and the operation repeated, which can be accomplished three times in 10 minutes, at a depth of 200 feet. The whole of one operation, resulting in the deepening of the hole 5 to 6 inches, and cleansing it of debris ready for the cutters or boring head being again introduced, is seen to occupy an interval of 20 minutes only. The value of these facts will be best shown by comparing them with the results by the old method.

At Highgate the boring has occupied two years in attaining a depth of 680 feet from the bottom of a well 500 feet deep from the surface. Their progress at present is at the rate of 6 inches per week, working night and day. At Warwick, 13 months were occupied in boring 400 feet through red marl. At Saltaire, two years in going 80 yards.

One well-known defect of the old method of boring consists in the "buckling" and dangling of the rods, which has the effect of enlarging the hole in some instances to a diameter of four feet where soft strata intervene. This arises from the buckling and dangling of the rods causing them to strike against the sides of the hole, and breaking off portions of earth which fall to the bottom. thus considerably increasing the quantity of debris to be brought up by the shell, and occupying an immense time in getting out the debris which has merely fallen from the side, without increasing the depth of the hole. This is a serious defect where geological purposes are to be served by the boring, because the earth from the side falling to the bottom of the hole mixes with that which is cut up by the chisel, and thus prevents an accurate knowledge being obtained of the strata which the boring has penetrated. It must be remarked also that the defect of buckling is to crystallise the iron, deteriorating its quality, and thereby causing those frequent breakages which retard progress, and add so materially to the expense of this system of boring. The process of crystallisation being beyond the observation of the workmen, the result is scarcely if ever known till the breaking of the rods reveals it. To remedy this difficulty, and obviate the effects of buckling, it has been found necessary to put down iron tubes into the bore-hole. As the first length of these tubes can scarcely be got to a depth of more than 200 feet, on account of the great external friction, it is necessary, when the tube has to be carried to a further depth, to put down a second and a third length of tube, and as each length must come to the surface, the diameter of the bore-hole is very materially diminished. It will easily be seen that when the bore-hole is required to be of considerable depth, this diminution of its diameter will at length so contract the hole as to render the supply of water comparatively limited, and in fact to threaten the design with actual failure after a vast outlay has been incurred. These inconveniences, so serious in character, are all obviated by the new method of boring. No rods are used, and as the rope which is substituted for them seldom comes in contact with the sides of the hole so as to disturb the strata tubing will rarely be required. Indeed, it will only be necessary when the particular strata through which the hole passes happens to be very fluid, and even then it will not always be wanted. The great power of pumping and the facility of winding possessed by this new machine would enable it to exhaust any ordinary quicksand which might find its way into the hole. The pumping process could be carried on at a depth of 500 feet at the rate of a cart-load per hour. It is possible with the improved machine to cleanse the hole so effectually that not a loose particle remains at the bottom. This will at once be seen from the fact that the pump has sufficient power to draw in masses of rock or other substances of from three to four pounds weight. This circumstance renders the machine particularly useful in geological researches, inasmuch as the lowest strata are brought up in a state of the greatest possible compactness and purity, notwithstanding any admixture of earth from the sides, or of that which the shell has been unable to bring up in the previous operation.

Some of the more important public uses to which the new machine can be applied may now be briefly enumerated.

Sanitary questions deservedly occupy at the present time a large share of public attention. Water, as is well known, is the chief agent in sanitary reform. It is necessary for flushing sewers, for supplying baths and washhouses, as well as for meeting the domestic wants of all classes of the community. The importance of cleanliness cannot be over-rated, as a means of promoting the general health, and it imposes the necessity for a much more copious supply of pure water than is as yet enjoyed in most towns. Many small towns which are so situated that they cannot command a supply of water from natural sources, are prevented from obtaining it by boring, on account of the great expense, and still more the vexatious uncertainty of the process. The corporation of Manchester have expended upwards of a million sterling in supplying that city and its neighbourhood with water, and they sell it to the corporation of Salford at the rate of threepence per thousand gallons. It is confidently believed that by the new method of boring an abundant supply of water could be procured on the spot at half that price. Thus, in a sanitary point of view, the new machine is of the utmost value since it enables us to procure a much greater supply of water in far less time, and from depths which were all but inaccessible on the old method of boring. For example, the work at Highgate, which has occupied two years, could have been done in thirty-three days. That at Warwick, which has occupied thirteen months, could have been done in twenty days. That at Saltaire, to supply the workpeople with drinking water, which has occupied two years, could have been done in twenty-nine days.

It must be borne in mind that water is seldom sought by the tedious and expensive process of boring till it is urgently wanted. The old method, therefore, not only occasions a vastly increased outlay, but also involves an amount of privation which in many cases is a matter of serious importance.

In conclusion, another important use may be noticed to which this invention may be applied, namely, the ventilation of mines, with a view of preventing the dreadful explosions which are unhappily too frequent. These explosions most frequently arise from the ignition of the gases or foul air accumulated in the galleries, or old workings, and in large cavities which have been partitioned off. The remedy in these cases would be to bore down from the surface and perforate these parts of the mine at different places, so as to admit a current of fresh air into the parts where the foul air had accumulated. On the old method of boring this object is impracticable, since, in addition to the expense, the diameter of the hole within reach of the old system is quite insufficient for the purposes required. The improved plan now proposed is not only (as has been shown) much more economical, but it is capable of boring holes of ample dimensions to be adapted as air shafts in the way proposed. A diameter of three feet has been suggested above, but the largest practicable limit is much beyond this. Instead of partitioning off the winding shaft, and connecting it below with a complicated system of passages for return currents, it would be found in practice much more useful to bore several holes, of a moderate diameter, at the end of the workings. On this plan the air would have only half the distance to travel, and the ascending shaft would not require to be kept at nearly so high a temperature, or, if kept at the same temperature, the ventilation of the mine would become so much the more effective and complete.

It is hoped that the facts contained in this paper will sufficiently prove the vast superiority of the new method of boring herein described, and the great advantage which will accrue to the community from its general adoption. Relying upon these facts it is presumed by the inventor that the improvements he has introduced will constitute a new era in the art of earth boring, and in the various important objects to which it is and may be applied.

The following certificates have been kindly given confirming the statements above made respecting the actual performance of the machine :—

[COPY.]

" Town Hall, Salford, Borough Treasurer's Office,
March 22nd, 1855.

" *To Messrs. Mather and Platt, Engineers, Salford Iron Works.*

" GENTLEMEN,—I have pleasure in certifying to the amount of cutting done by your admirable and highly-ingenious earth-boring machine, during my visit at your establishment this day.

" The bore-hole was 15 inches diameter, and 205 feet 3 inches deep when the machine was set to work; the operations of lowering, working, and raising the boring head, and of lowering, working, and raising the pump, and the broken rock, occupied nineteen and a half minutes.

The depth of the hole was again measured, and found to be 205 feet 10 inches; shewing that the machine had cut the red rock, and brought to the surface, *seven inches* in depth.

"The machine appears to me to be exceedingly well-adapted for the performance of the work it has been constructed to perform, and being worked by a steam-engine, requires the attention of only two persons.

"The work performed in my presence is equal to 21½ inches per hour, or about 18 vertical feet per day of ten hours.

"The following is the actual time occupied in each movement of the machine:—

Lowering boring-head	1½ minutes
Boring	10 "
Drawing up boring-head	1½ "
Lowering pump 1st time	1½ "
Drawing up pump and broken rock	1 "
Lowering pump 2nd time	1 "
Drawing up pump 2nd time	1 "
Lowering pump 3rd time	1 "
Drawing up pump 3rd time	1 "
Total time	19½ minutes.

"Vertical depth bored through red rock in well 1^5 inches diameter, *seven inches;* being at the rate of 21½ inches per hour, or about six vertical yards per day of ten hours.

"E. R. LANGWORTHY,
"Alderman and Justice of the Peace."

"I was present during the above-mentioned operations, and took the time of working Messrs. Mather and Platt's extraordinary machine, which is correctly stated above.

"DAVID CHADWICK,
"Treasurer of the Borough of Salford."

DISCUSSION.

Mr. HERBERT MACKWORTH, M. Inst. C.E., Government Inspector of Mines, said, every one must feel indebted to the gentleman who had illustrated the paper which had just been read by the elaborate diagrams and the beautiful working-model before them, but for himself he felt thankful to any one in this country who would devote himself to the improvement of boring, an art of the highest importance to our mineral resources, but which, unfortunately, for many years had been left to continental engineers to improve and extensively apply. Ryan, at the close of the last century, took out a patent for improvements in boring and a mode of extracting large lumps of rock as specimens, and he was followed by Goode, in 1823. On the Continent, the names of d'Oeynhausen, Degousée, and Kind (the so-called Napoleon of borers), had become famous from the great practical success which had attended their improvements; whilst in England we had been satisfied to go down 300 yards, at enormous cost and with great uncertainty. Kind had executed borings 764 yards deep at Mondorf, 566 and 626 yards deep at Brunswick, and 742 yards at Minden. These borings were for salt brine. He was lately executing one at Homburg, which had attained a depth of about 600 yards, to obtain water sufficiently hot for warm baths. The Parisians regretted that their well of Grenelle, 600 yards deep, made by Mulot, was not a few 100 yards deeper, so as to obtain water for warm baths without the necessity of re-heating it. The Chinese system had been the foundation of so many trials in boring, that it was worth mentioning that Imbert related that boring was executed there for obtaining carburetted hydrogen gas, to a depth of 600 yards, by a heavy chisel suspended to a rope. This system was applied some years ago at Chatham; it had been much improved on the Continent by Jobard, Selligue, and Sello, the latter of whom applied it to drawing off fire-damp from certain portions of coal mines, as recommended by the author of the paper. It would rarely be found beneficial in coal mines, from the small area of the shaft, the influx of water into the mine, and other objections. Mr. Mather's method contained improvements on the Chinese system, but exhibited some of those first and rather crude steps which had been previously tried before success was obtained. The Société Freminville employed apparatus of a very ingenious kind, and, to obviate the great objection to the Chinese system, the crookedness of the hole, tubed the interior so as to serve as a guide for the tool itself. No system had ever shown such wonderful results in one or two instances under very favourable circumstances as Fauvelle's. M. Arago related, that in July 1846, at Perpignan, 186 yards in depth were bored in 23 days, or 140 hours, being more than double the very favourable statement of the performance of Mr. Mather's machine. That this system had not come into general use, was owing to several important defects, which it was unnecessary to go into now. He gave it as an example that the merits of improvements in boring must not be tested by what they would do in flat beds of new red sandstone, or Halifax flags, such as we saw on the table, and for half an hour at a time, but by actual proof, in deep, hard, and highly-inclined strata. Although the present system had been started at least as far back as 1848, it did not appear to have attained a greater depth than 80 yards, and only to have been tried for a few feet in stone of the same consistence as London pavement flags, in which its performance was unrecorded. As a practical man, he did not like to take the statements of actual performance which had been made to us, but which were no doubt quite correct, as a proof that this method had been perfectly successful. There was no art in the whole range of engineering which required greater practice, skill, and care, than that of boring. Neither the boring head nor the shell pump, however well they might answer for soft rocks, seemed calculated for hard and highly-inclined beds. He should like to hear of some actual comparison under the same conditions between this pump and the ordinary shell, for it did not seem probable at first sight that a more rapid current of water could be obtained through the bottom valve by a suction-pump than by allowing the shell and heavy rods attached to fall downwards in the water. It was very important to have all tools used at the depth of several hundred yards as simple in construction as possible. A great difficulty found in these rope borings occurred when the boring tool broke and jammed, as then rods would probably have to be put down to extract the tool, if the hole was not altogether abandoned. The chief difficulty consisted, however, in boring the holes so true and straight that tubes could be put down to secure the soft strata when necessary, a difficulty which the boring-head exhibited was hardly calculated to overcome. It might be desirable, for the purpose of calling the attention of persons interested in borings, to those improvements which had had the test of long practice, to mention that the great steps which had been made were due mainly to the introduction, by Mr. Kind, of the free-falling tool, the substitution of wooden rods for iron, and a means of cutting out cores in the holes as specimens. The free-falling plan left about sixty feet of the rods attached to the chisel to fall with it. As the upper part of the rods acted only to suspend the tool and raise it, they did not fall with their weight upon it to jam against the sides of the bore-hole, which was the main cause of the delays and accidents in ordinary boring. By introducing light wooden rods, and the free-fall system, when the Mondorf boring was half-executed, the lower half of the hole was bored in less than half the time and cost of the upper half. Some of the borings which he had seen in operation were proceeding at the rate of from eleven to fifteen yards per week. The diameter of the hole was 1 foot, the weight of the tool 10 cwt., the number of strokes from 8 to 25 per minute, and the fall varied from 1 to 3 feet. By means of a crown borer and a cylinder with teeth inside, cores 8 inches in diameter, and from 1 to 3 feet long, were brought up and laid on the surface of the ground in the same relative position which they occupied underground, so that the amount and direction of the dip of the strata could be ascertained, as well as the commercial value of the mineral gone through. The following table contained some interesting particulars of borings which had been executed:—

ABSTRACT OF REGISTERS OF BORINGS ON KIND'S SYSTEM.

LOCALITIES.	Diameter of Bore.	Depth in Yards.	Time in days of 12 hours.	Cost of labour and material per yard.	Cost of the Boring.	NATURE OF THE ROCKS.	OBSERVATIONS.
	Inches			£ s. d.	£ s.		
At Montmorot Jura, No. 1	12	164	84	0 19 8	160 10	Shifting sand and gravel, 33 yds., lias marls, 43 yds., gypsums, 66 yds., saliferous, 22 yards.	Without cost of installation, and carriage of tools, &c. Employing a small engine and attendant.
Do. No. 2	do.	185	112	1 2 0	203 12	Do.	
Do. No. 3	do.	309	in progress.				
At Stiring Moselle, No. 1	do.	327	354	0 19 1	311 11	N. red sandstone, 88 yds., carbfs. grits, and shales 131 yds., coal measures, 108 yards.	
Do. No. 2	do.	355	422	1 0 11	372 5	Do.	
Do. No. 3	do.	295	330	0 19 8	289 11	Do.	
Do. No. 4	ft. in. 4 0½	120	216	1 4 4	146 0	Do.	
At Guines Pas de Calais	12 In.	263	86	1 1 9	285 17	White Chalk, 100 yds., hard grey chalk, 163 yards.	
At Vizernes Do Boring 764 yards	12 In. deep.	159	37	1 0 7	164 0		Without cost of installation but including tubing.
At Mondorff, Grand Duchy of Luxembourg by old system	10 In.	371	37mon	5 1 0	1873 0	Chalk, 46 yards, white grit, 14 yards, keuper, chalk, and gypsum, 86 yds.	
by new system	10 In.	393	14mon	2 2 0	829 0	Gypsum, 35 yards, red marls 87 yards, quartz grit and red sandstone 292 yds.	

One shaft, which he saw at Forbach, had been bored of a diameter of fourteen feet, to a depth of 100 yards, in nine months, by means of chisels fixed on iron arms, and worked in a simple manner by a 12-horse engine. He was happy to admit that Mr. Mather's machine, though not altogether new, exhibited great ingenuity; it offered many suggestions, but he had failed as yet to show that it was capable of boring to 1000 yards, or one quarter of that depth. Fauvelle's system gave, as he had shown in one instance, a much higher result, but failed in some others. Practical men, especially in a matter of boring, required the test of practice, and the question of cost had not been touched upon at all. Improvements in rope boring had always offered a very tempting field, from the facility with which the tool was raised up and down; and, in the hands of gentlemen of so much energy and enterprise, there was great hope that the difficulties hitherto attending it might be overcome. The criticisms he had ventured to make were in no unfriendly spirit, but with the view of awakening inquiry, and to promote the discovery of those vast resources of coal which there was no doubt lay for hundreds of miles in extent along the edges of existing coal-fields, but were covered up with the new red sandstone. By knowing what had been done on the Continent, we knew what we had to do to excel— a success he trusted there would be no delay in attempting, and he should be very glad to see the inventor of this system fill up this vacant niche in English mining engineering.

Mr. **FRASER** would not attempt to follow Mr. Mackworth through his excellent *resumé* of the improvements in earth-boring, but having given particular attention to the plan before the meeting he would refer to what he considered its distinctive features. He had lately deepened a well by boring in the chalk 125 feet; the original depth was about 400 feet. The plan adopted was the old system of jointed rods with a chisel at the end; after the rods had been worked for a considerable time, the rods were disconnected and the shell screwed on in the place of the chisel to remove the debris; the chalk through which the tool passed was completely pulverised, and the result of a day's work was often very dispiriting; the smallest of the specimens shown by Mr. Mather were larger than any he had seen brought up by the old shell; their circular boring head had dislodged the pieces of red sandstone and limestone now exhibited, and the facility with which the tool could be raised or lowered 400 or 500 feet per minute, for the purpose of repairs, was one of the great improvements. He thought that sufficient attention had not been drawn to the shell pump, which they used after the boring-head had done its work. It could be lowered to the bottom of a boring equal in depth to the celebrated well at Grenelle, and discharge its contents on the surface in less time than the speaker had occupied, bringing up pieces of iron and broken parts of the boring tool, through the partial vacuum formed by this ingenious pump. He thought that it would be unnecessary to go to the Continent in future for an engineer to sink a well similar to the one in progress at Highgate, and that Mr. Mather was deserving of their thanks for a paper which was worthy of place amongst the important papers which had been read to the Society during the session.

Mr. **HOMERSHAM**, C.E., had had some experience in boring, especially in chalk, though not to the very great depths mentioned by Mr. Mackworth. He had bored to depths of from 400 to 500 feet, and looking to the best systems of boring that had been in use in this country, and looking to the machine before them, he considered that a great improvement would be effected by means of it. He thought the shell-pump, as there applied, to bring up the *debris* from the bottom of the bore, would be the means of fetching up the broken rock much quicker and with greater certainty than was done by the use of the common shell and miser. He, therefore, was not surprised to see the large piece of iron that had been brought up by the shell pump from the bottom of a deep hole, and which was exhibited upon the table. In fact, the deeper the boring was, the more effectual would be the action of the shell pump, owing to the great power of a high column of water rushing into the vacuum created by the action of the piston. The apparatus being entirely worked by steam instead of by manual labour, he considered a great improvement upon the old system of earth-boring, and he felt that they were under great obligations to Mr. Mather for having so ably brought the subject before them.

Mr. **MACKWORTH** would be glad to hear from the inventor whether he could give any idea of the comparative working of the ordinary shell and the pump used by him; whether they had been tested under similar circumstances?

Mr. Mather said, with reference to the power of the pump in comparison with the ordinary shell, the great difficulty with the latter had been to remove the loose gravel from the bottom of the boring, as the shell could not get hold of it; but send down this pump, and every particle of gravel or sand was taken into it by the absorbent power possessed by the pump, by which means the bore-hole was kept perfectly clear at the bottom. This could not be the case with the old shell, which, under any circumstances, would leave a portion of *debris* in the hole. Specimens of broken cutters, and a ball of iron weighing three to four pounds, were here produced, which had been brought up by the shell-pump from a depth of nearly 200 feet with the greatest facility. Mr. Mather entered into an explanation of the grapnell by means of which the boring-head, weighing 17 cwt., could be at once taken out of the bore in case of its becoming detached by any accident, and stated that in the only case in which this event had occurred the boring-head was so recovered, with the loss of a few minutes only in time. With reference to the hardness of the strata which had been bored by this machine he thought the specimens on the table afforded a sufficient test of the capabilities of the machine.

Mr. Hensman remarked, that the objection to this instrument taken by Mr. Mackworth had been with regard to its use where the strata existed at considerable inclination. He (Mr. Hensman) thought that by increasing the length of the boring head, there could be no difficulty in sending it through strata of considerable inclination. As regarded the valve at the bottom of the pump, he thought an improvement might be made upon that which the inventor had employed. He would ask what was the greatest length of boring head they had used.

Mr. Mather replied about 8 feet.

Mr. David Chadwick (of Salford) said, having had an opportunity of seeing the machine at work, he should be wanting in his duty if he did not bear his humble testimony to its great efficiency. He had witnessed its operation, when the work performed was equal to 21 inches per hour, or 6 vertical yards in 10 working hours. As an earth-boring machine, he considered the invention one of very great importance, and as every town was now being supplied with water from artificial sources, such an instrument was of great value. He thought this machine had been unnecessarily depreciated by comparison with the Chinese system of boring with a rope, of which he had heard, but it had never occurred to him that the inventor was indebted to that method for the improvements he had effected. The machine might be compared to a combination of Nasmyth's steam-hammer with the boring tool, and was as perfectly under the controul of the operator as the machinery of a steam-boat upon a river; besides which, the operation was most rapid, with an absence of all complication. In the Philosophical Transactions of the Royal Society would be found a most amusing and interesting account of the boring of the artesian well at Holland House, where great difficulty was experienced. It would seem, from the observations of Mr. Mackworth, that they were chiefly indebted to foreigners for all that was great and good in earth-boring, but there was something to congratulate themselves upon—that this was the invention of an Englishman, although he was not there to say that it was not susceptible of improvement, to which no doubt the inventor himself was alive. Mr. Mackworth had objected that boring through red sand-stone was not a sufficient test of the capabilities of the machine to penetrate hard strata, but it was to be recollected that this was, comparatively speaking, a new invention, and he believed he witnessed the boring of the first hole by it. At the same time, Mr. Mather himself was no novice in the practice of boring, and therefore, if objection were made to the machine, it could not be upon the score of inexperience in such operations, and that would not prevent any improvement being pointed out. He would only further remark that he believed the machine had been at work in Yorkshire upon a material that would sufficiently test its capability for perforating hard substances, and had been found to work most satisfactorily. Beautiful as was the model before them, they could form no idea of the practicability of the invention, without seeing the machine at work. He had himself the highest opinion of its efficacy as an earth-boring instrument, and he considered it a decided improvement upon existing methods.

Professor Tennant inquired what thickness of the harder stone exhibited upon the table, had been gone through in the boring on which the machine was now occupied.

Mr. Mather replied about six yards.

Professor Tennant thought that was a very good test, as it was a far harder material than any of the specimens of red sandstone on the table. He had only just come from an inspection at the Geological Society, of specimens of the silicious pebbles from the boring at the Highgate-road well, which were harder than any of the strata before him, and when a boring machine had to contend with that it was very formidable. He had learned that day, that they had got to a depth of 1200 feet with that boring, and that during the last 12 days it had gone on very rapidly, the depth having been increased from 1166 feet, to 1200 feet.

Mr. Carter, of Halifax, said, with regard to the silicious pebbles, the professor would find that the flint formations in the chalk, though probably of equal hardness, did not present nearly as much difficulty of perforation in ordinary cases as the stratum of which the piece on the table was a specimen.

Professor Tennant—This is a limestone.

Mr. Carter replied, that the stratum, though containing lime, could scarcely be called limestone; the labour of perforating it, however, presented a work of great difficulty, owing to the thickness and the compactness of the material; but although the progress through it was slow, it was equally certain and sure. With reference to the boring head, he would remark that to adapt it to hard material of this nature, the cutters had been reduced to half the length of those in the implement exhibited on the table. By this means the required stiffness had been obtained. He remarked that the machine had only been experimentally tested in the new red sandstone until it had been very recently applied under his direction in the neighbourhood of Halifax, to the far more variable and difficult stratification of the coal measures and underlying rocks of the millstone grit formation. It was only a few days since the hard and compact rock had been penetrated, and they found that a little more time was necessary for the perfecting of the instrument to adapt it to all the different kinds of strata which might have to be perforated. With reference to the pump-shell, he was satisfied that as they obtained by its action an almost complete vacuum, specimens like those on the table would be brought up with perfect facility, whilst the improvements in the implements might remove all difficulty in the perforation even of material as hard as that exhibited on the table.

At the request of Mr. Wilson, Mr. Mather explained the action of the steam-engine in lifting the boring-head.

The Chairman then conveyed the thanks of the meeting to Mr. Mather for his very interesting paper.

The Secretary announced that on the evening of Tuesday next, there would be a meeting at the Society's house in reference to the Trade Museum, which members were invited to attend. Also that there would be no Ordinary Meeting on the evening of Wednesday next, the 6th of June, as on that day the private view of the Chalon Exhibition would take place.

THE PAST AND PRESENT POSITION OF LIFE-BOATS.*

BY ANDREW HENDERSON, M.S.A., & ASSOC. INST. C.E.

The term "Life-boat" was, properly speaking, first applied to a boat invented by a Mr. Henry Greathead, of South Shields, for the purpose of preserving the lives of shipwrecked persons. The following circumstances gave rise to this invention.—

In September, 1789, the ship *Adventure* was stranded on the Herd sand, on the south side of Tynemouth harbour, amidst tremendous breakers—the crew dropping from the rigging, one by one, in the presence of thousands of spectators, not one of whom could be prevailed on by any reward to venture out to their assistance.

On this occasion a committee of gentlemen of South Shields offered premiums for plans of a boat which would best resist the dangers of the sea, particularly of broken water. The preference was given to Mr. Greathead's design. Being the first boat built for this special purpose, a description of her will be interesting, especially as we possess a model, presented to the Society of Arts by its inventor upwards of fifty years ago. It will be seen that this was a broad shallow boat, with rising floor, curved keel, and very great shear of gunwale, with three sliding keels, the sides and inside of bottom being lined with near 7 cwt. of cork. After many years of trial, Mr. Greathead petitioned the House of Commons; a Committee of the House took evidence, and awarded him £1200. Beyond this, he received from Lloyd's 100 guineas; from the Corporation of the Trinity House 100 guineas, and from our Society of Arts a gold medallion and 50 guineas. Such was the reception Mr. Greathead deservedly met with from scientific and other societies of his day for this first step towards the construction of a truly useful life-boat, which, if not perfect, was at least well adapted to the north-east coast of England.

It may be observed that this type of the English life-boat, being broad and flat-bottomed, with bilge-keels, was enabled to cross the bars of rivers, or to land on a beach in little water, and like the Musulu boats on the Coromandel coast, was without ballast, extra buoyancy, or means of freeing itself from water. Both boats steer with an oar, and are entirely dependent on the skilful management of an experienced crew on the coast or harbour where they may be stationed. The sliding keel is of much use in deep water, or when the boat is under sail, and being easily removed, it forms no impediment in launching or communicating from the shore to a stranded ship, as a shore life-boat.

The first effort to provide means of communication with the shore from the wrecked vessel herself, or a "ship's life-boat" appears to have been made, in 1828, by the late George Palmer, Esq., of Nasing-park, formerly a commander in the E.I.C. merchant service, and lately M.P. for Essex, and deputy-chairman of the National Institution for the Preservation of Life from Shipwreck. Through this Institution, in 1828, Mr. Palmer circulated a sketch and specification of his boat and fittings, the extra buoyancy consisting of air-cases and casks in the wings, bow, and stern, under the thwarts. She was built as a whaleboat, sharp at both ends, so as to pull against a head sea, with few hands, to draw little water, and to be light in weight. After undergoing practical trial in 1828, the model was adopted by the Shipwreck Institution, and from that period to 1854 twenty-nine life-boats on this plan have been placed on the coast, many have been carried by Indiamen and other ships, and some established by the French Government.

The great shipping ports of the Tyne on the east coast and the Mersey on the west, having most requirement for the services of life-boats, possess the most efficient establishments, maintained at Shields, Sunderland, and other ports by local committees, while the Liverpool Dock Trustees have life-boats on six stations at the entrance of the Mersey and Dee.

Those on the east coast are of the form of Greathead's life-boat, modified by the introduction of buoyancy under a platform, or water-tight deck, with tubes passing through to allow the boat to free herself of water if shipped in a sea way—some having the addition of water ballast under the platform. The Liverpool life-boats on Costain's model are a modification of Mr. Palmer's form and fittings, but are of greater breadth and rise of floor, the extra buoyancy consisting of air-casks under the thwarts. They have, however, neither iron nor water ballast, relieving tubes, valves, nor self-righting power. But during the last fourteen years' service they have assisted 312 ships and saved 1261 lives without upsetting. They are fitted with sails, are generally towed out by steamers, and are maintained with experienced crews, at a cost of £2,000 a year.

In 1849, the Tyne life-boat, manned by 24 pilots, went out to aid the *Betsey*, on the Herd sand; when alongside a heavy knot of sea recoiling from the bow of the vessel caught the bow of the boat and turned her up on end, throwing the crew and water ballast into the stern sheets; she turned completely end over end, and went on shore bottom up, when 20 out of 24 of the crew were drowned under the boat. This occurred to a large improved boat, 33 feet by 11, very broad and shallow, with round floor and great sheer of gunwhale, a water-tight platform or deck one-third the depth above the bottom, covering an air case of 22 cubic feet, with a water ballast tank, open at top or centre, containing 30 feet, air casks fore and aft under thwarts, delivering tubes through deck, and bottom fitted with valves.

This sad accident was partly attributable to the movement of water on the platform and in the ballast tank. The form and fittings of this boat are given because this lamentable loss of life, with other shipwrecks, induced his Grace the Duke of Northumberland to offer the sum of 100 guineas for the best model of a life-boat, to be sent to the Surveyors' Department of the Admiralty by the 1st of February 1851. The chief objections to the present life-boats were then stated to be, 1st. That they do not right themselves after being upset. 2nd. That they are too heavy to be readily launched. 3rd. That they do not clear themselves of water fast enough. 4th. That they are very expensive.

Captain Washington, R.N., (the present hydrographer,) and a committee of naval officers and surveyors, were appointed to examine the models and award the prize. The result was, that 280 models and plans were sent for consideration, many of which were exhibited at the Great Exhibition. In June 1851 the Committee made their report, agreeing on fifteen points which they considered the essential qualities of a life-boat, with numbers in the order of their precedence making 100. The numbers adjudged to 37 boats varied from 60 to 84. The prize was awarded for the latter number to Mr. Beeching, of Great Yarmouth, his being considered to be the best model of a life-boat.

This report, accompanied by plans, drawings, and detailed descriptions, was prepared at the expense of the Duke of Northumberland, and 1,300 copies were gratuitously distributed by his Grace, affording much useful information, most difficult of attainment, not only with regard to our own coasts, but to the maritime nations of Europe and America. His Grace at the same time expressed his intention of placing the best life-boats that could be built on all the exposed points of the coast of Northumberland.

A catalogue of the models and plans gives the length, breadth, depth, weight, and cost of all. Thirty are described in detail, with observations, and there are published plans and sections of the internal construction and disposition of buoyancy of thirteen life-boats, commencing with Mr. Beeching's prize model, which is stated to be ballasted with two tons of water and with a half-ton iron keel. By means of raised air cases at the extremities it was said she would right herself. Remarks were also made on her great weight and deep keel, and that through the large area of tubes, with the crew on board, the water would be above the decks.

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* This paper was to have been read at the meeting of the Society on the 18th of April, but the time at the disposal of the meeting did not admit of this being done.—SEC.

There are plans of Teesdale's and Farrow's boats, on the principle of water-ballast under a platform, and of Hinks, Plenty, and others, having the space below the platform filled with cork. Also plans of boats by George Palmer, Esq., Costain, of Liverpool, White, of Cowes, and others used on our coast, having their buoyancy in air cases, casks, or compartments at the side and bilge of the boat.

The report states, that the different boats are delineated, to enable a boat-builder to make choice of one adapted to his coast; and that Mr. Peake had prepared a drawing, showing a plan and section of a thirty-feet boat, in which, profiting by experience in the examination of the models, all the best qualities of a life-boat are said to be combined.

The Committee state the conclusions they have come to as to form, dimensions, material, and internal fittings, adding that the breadth should never be less than one-fourth the length, and the depth one-third the breadth, the weight one and a quarter cwt. for each foot of length; a fair rule. Extra buoyancy, or that required beyond the materials used in the construction of the boat, is described as the characteristic feature of a life-boat requiring great consideration. The report concludes with the life-boat regulations of the Royal National Institution for the Protection of Life from Shipwreck, of which his grace the Duke of Northumberland had become president, and the naval officers who awarded the prize became members of the committee of management.

With this report was published a "Wreck Chart," on which were marked the life-boat stations and wrecks at the principal ports of England, Scotland, and Ireland in 1850, with a statement that there had been 681 vessels wrecked on the three coasts, causing the loss of 784 lives, while there were only 96 life-boats on the whole of the coasts of the United Kingdom, half of which were unserviceable, thus showing the urgent necessity for extending an improved means of preventing shipwreck and loss of life by the increased establishment of more efficient life-boats. These objects were promoted through this, the Society of Arts, in March, 1852, by the diffusion of valuable information, contained in the admirable paper on the "Progress of Naval Architecture," and on "Life-Boats," by Captain Washington, R.N., (14th lecture on the Results of the Great Exhibition,) in which he passes in review the principal established life-boats and models, and offers opinions as to their essential qualities, and suggests the means of diminishing the frequency of shipwreck and thus preserving life when exposed to it, concluding with the opinion that past experience declares the means are within our reach, the question only needing to be grappled with in earnest to overcome all difficulties.

Concurring in these views, I have for many years taken deep interest in the management of the "Shipwrecked Fishermens' and Mariners' Society," especially since its incorporation, in 1850, with the establishment of a department to provide life-boats on the coast, and exhibit an improved construction of fishermen's boats.

With this object, as a member of the Life-boat Committee of that Society, I concurred in the purchase for £50 of Francis's corrugated-iron life-boat, stated to weigh half a ton, and to be adopted by the government on the coast of America. She was brought to this country by the frigate that brought their produce to the Great Exhibition in 1851, where her model might be compared with the prize model and many of the 280 competitors; but, unlike the prize model, her trials were made on a full-sized boat at Woolwich, where she was found to weigh 19 cwt., was deficient in stability and buoyancy, and was reported to be unsuitable as a life-boat by the Northumberland Committee.

The Northumberland report and prize-boat, the Great Exhibition, and the publication by this Society, had created much interest and competition in the construction of an efficient life-boat, together with some dissatisfaction that the prize had been awarded without any practical trial of a full-sized boat, and a feeling existed that too much importance had been attached to the property of righting herself when upset.

The very great diversity in the form, fittings, and material of the 280 models proposed, renders it most difficult to ascertain their relative merits. A boat admirably adapted to one locality and service, may not be found efficient in others; and again, an experienced and skilful crew can work a boat with safety and efficiency, which, in the hands of strangers, would be comparatively dangerous.

To facilitate comparison, since the publication of the Northumberland report, I adopted their tabular form, containing the particulars and dimensions of the principal life-boats competing for the prize, and I have added further particulars in twenty columns, to afford a closer analysis of their relative proportions, resistance, form, bulk, displacement, and buoyancy, and the form is illustrated by diagrams of their midship sections, and the angle of light and load water lines, with a short account of the properties and service of each.

This table* comprises the Musulu boat, so much used on the high surf on the Madras coast without life-boat fittings. There are five of the type of Greathead's boat, the Tyne and Shields boat, elaborately fitted with cork, air-cases under deck, delivery tubes, and water ballast, including Beeching's prize model.

Lines 8 and 9 exhibit the Percy life-boat, built at Woolwich Dockyard, for the Duke of Northumberland, on the plan recommended by the Committee as a guide, in which all the best qualities of a life-boat should be combined. She was completed November, 1851, and when tried was found to possess very great stability and buoyancy; but when turned keel upwards, she could not be righted by the crew, till lifted over by the crane. It was evident at the trial that she had too much stability to be sea-kind, and would be uneasy and slow in a seaway.

The dimensions of this boat will be found in the 8th line, the proportions of length being 3·41 times the breadth, and a depth of 0·51, or half the breadth; the external bulk being 519 cubic feet to the height of gunwale amidships, with a displacement loaded to two-thirds the height of gunwale of 9 tons 5 cwt., and at light line 3 tons 18 cwt., on a draft of water of 14 inches, thus exhibiting a very great capacity for weight or burthen.

As to form, a reference to diagrams will show this boat to have a very flat floor of only two degrees rise, with straight sides, the angles of the light water lines from the midline being 22 degrees, and of the load lines 34 degrees.

Line 9 exhibits the same boat altered by Mr. James Peake, reducing the breadth 9 inches; thus increasing the proportion of length to 3.71 breadths; decreasing the angle of water line to 12 and 16 degrees light lines, and 22 and 25 degrees load line; and also increasing the rise of floor. Two other boats, of 21 and 27 feet, built on this model at Blackwall, had three feet added to their bows, to bring them to the same proportions.

The internal fittings of these boats underwent repeated alterations, resulting in the removal of three-fourths of the cork under the platform, and the substitution of air compartments formed between water-tight bulk-heads across the boat. The wing or bilge space for one-third the length was fitted with boxes containing from three to four cwt. of cork as buoyancy and ballast, the latter increased by a cast-iron false keel of from five to seven cwt.

*** This table may be obtained by application to the author.**

A platform, or water-tight deck, a little above the line of flotation (except a space amidships occupied by a well for anchor and cable) has four delivering tubes on each side through the bottom, fitted with self-acting valves, that relieve the boat of water to the line of flotation, and prevent its admission from without.

The alterations in the form and fittings of these boats occupied many months. The boat built at Woolwich at the expense of the Admiralty was tried at Brighton. It was found to right herself, and was eventually established at Cullercoats. Six boats, on the modified plan, were placed by the Shipwreck Institution at the ports mentioned in lines 11, 12, and 13, and have been tried on their several stations. There is no information published as to the detail of their alterations, trials, and fitting, but judging from the boats now in course of construction, the experience gained by these costly experiments and alterations have led to great improvement in the form, workmanship, and disposition of buoyancy and ballast upon the boat originally designed. They are different from the prize model of Mr. Beeching, both in principle and detail. Such boats are well adapted for the Coast Guard, and all stations where there are experienced crews, but they require great care, are not adapted to other purposes than life-boat service, and are more costly and heavy than was expected.

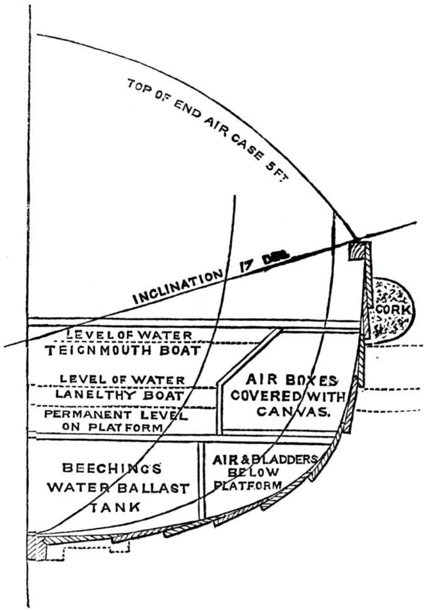
The "Shipwrecked Fishermen's and Mariners' Society" being the other only public body that has undertaken the provision of life-boats, it may be necessary to state, that it was instituted in 1839, by gentlemen connected with the mercantile marine, to provide for all sea-faring people shipwrecked on our coasts, and to assist fishermen, seamen, or their widows and families, on a subscription of 2s. 6d. per annum. The number of subscribers exceeds 36,000, many of whom contribute 3d. per annum towards the life-boat fund, which, together with a grant, donation, and subscriptions, exceeded £2000 in 1852.

The society was incorporated in 1850, and is under the patronage of influential noblemen, and the management of a large Committee, principally of naval officers, the subscriptions from fishermen and seamen exceeding £6000 a year, with donations to the amount of £1000, which enabled them, in 1853, to relieve 5,474 shipwrecked persons, mariners, and widows. These funds are admirably distributed through the instrumentality of 500 honorary agents in different parts of the country, and the systematic arrangements of the central office in London are well carried out by the secretary and travelling secretary.

The Life-boat Committee of the society commenced operations by the purchase of Francis's corrugated iron life-boat. When there was much difference of opinion as to the claims of Mr. Beeching to the prize, and when the best life-boat was still an open question, the Life-Boat Committee of the Shipwrecked Fishermen's Society, or a limited number of them, including the paid secretary, Mr. T. Lean, Purser, R.N., adopted the prize model for the Society's boats, ordering three from Mr. Beeching, on his own plan and terms, viz., £4 9s. per foot.

The peculiarities of Mr. Beeching's model and patent mode of fitting life-boats will be seen by reference to the annexed diagram of the midship section, from a drawing and specification of a 28-feet boat, which was tried at Woolwich dock-yard in November 1851, in the presence of the committee who awarded the prize. This boat, estimated at 22 cwt., weighed 29½ cwt., and with oars, sails, and crew, 50 cwt. She had 19 cwt. of water ballast, and when upset under a crane righted herself readily. With crew on board, she drew 20 to 21 inches of water, the tubes admitting water 4 or 5 inches on top of platform. (See diagram.) This boat was sent to Teignmouth and tried 15th January, 1852, and when turned over under the crane lay bottom up three or four minutes, and with a crew of twelve men the water rose to within two inches of the thwarts. In December 1851, the Lytham boat, of the same dimensions, was tried at Liverpool by myself, and the secretary Mr Lean and when upset under the crane she righted herself; but on the suggestion of Mr. Beeching, some 14 or 16 men getting on one side, she upset, and remained bottom up three or four minutes, till assisted by the Liverpool life-boat men, most of whom expressed their opinion that she would prove dangerous.

BEECHING'S PRIZE LIFE-BOAT.


TOP OF END AIR CASE 5 FT.
INCLINATION 17 DEG.
CORK
LEVEL OF WATER TEIGNMOUTH BOAT
LEVEL OF WATER LANELTHY BOAT
PERMANENT LEVEL ON PLATFORM
AIR BOXES COVERED WITH CANVAS.
BEECHINGS WATER BALLAST TANK
AIR & BLADDERS BELOW PLATFORM

In 1852, the society sent the prize-model boats to Tenby, Llanelly, Port Madoc, and Newhaven. The annexed midship section of one of these boats shows their form and fittings; the results of their trial being most important, I will here give a description of one of them. The platform, or air-tight deck, is one-third of the depth above the bottom. The principal feature is the water-ballast tank, extending over three-sevenths of the length and three-fifths of the breadth amidships. A 28-feet boat will contain upwards of a ton of water. The air space at the side and end is filled with bladders. Eight four-inch tubes pass through the ballast-tank and bottom, relieving the boat of water to the level of flotation. Practically, all Beeching's boats retain the water at a permanent level of four or five inches above the platform for three-fifths of the breadth, as shown on the diagram, and thus, when under sail, or laid over by a sea, this water, shifting to leeward, acts as a counter ballast; and as seen in diagram, the Teignmouth boat, with an inclination of 17°, would have her lee gunwale immersed, and of some three tons of water above the platform four-fifths would be on the lee side, and should the compartments under the platform not be perfectly tight, the water ballast would also shift to the lee side, leaving air or vacuum on the weather side; the alternate pressure of which and the water on platform, actually draws the oakum from the seams.

The *self-righting* power of Beeching's boats was obtained in the prize model by very large air-compartments in the bow and stern, occupying two-fifths of the length and as high as the stem above the gunwales, as shown in the midship section; these compartments contained 30 to 60 feet of air or buoyancy, and forced the boat to right herself, when turned under a crane, or upset; but experience proves that when often repeated, or in a sea way, its efficiency was neutralised by leakage, the increased weight of the boats rendered assistance necessary to right them. This is illustrated by the diagram, where the curved line shows the position of the end air-cases from stern to gunwale, which when the boat is turned over would be immersed to the level of the thwarts.

Francis's iron life-boat, before mentioned, was tried on the east coast by the secretary, and sent to Rhyl in 1851. On the first attempt to assist a vessel in distress through a cross sea, the water inside the boat remaining above the thwarts, she became water-logged, and was obliged to return. The local committee, requiring a more efficient boat, I proposed to substitute, for her air-compartments under the thwarts, a modification of the internal fittings of Beeching's boat, placing instead of tubes through the boat self-acting relieving valves, at the line of flotation, with pumps for discharging the water below it. These, with an altered disposition of her buoyancy and ballast, were proposed to remedy the want of stability and readiness to become water-logged, so far at least as her peculiar form and materials would allow.

The Society's prize boats having similar difficulties, after several experimental trials the internal fittings of Francis's boat were altered. The amount of water-ballast was reduced, and placed in two separate tanks, fore and aft, one-fourth the breadth amidships, with three wells. The bilge was filled with fishermen's cork, covered with bottom boards rising at the sides. The self-righting power was obtained from air-compartments in bow and stern, of much less capacity than in Beeching's boats. The additional cork and materials increased the weight of the boat to 30 cwt., so that on trial, when upset under the crane, she remained keel up, like the Tynemouth and Lytham boats, till assisted by the crew, and as was the case with the Percy life boat on the first trial at Woolwich. This was mainly attributable to the air-cases under the thwarts and in the bow and stern admitting large quantities of water, it being found impossible to make them tight, though of a very costly construction of gutta percha and planking.

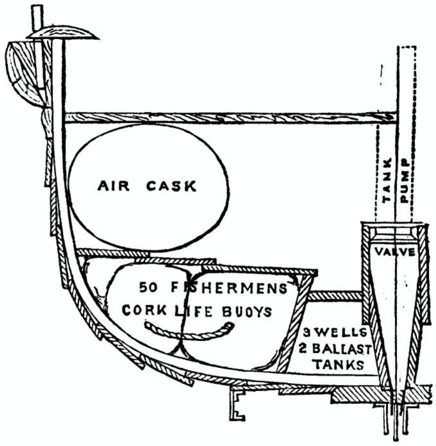
The result of these costly trials and experimental alterations confirmed my opinion of the total inefficiency of Beeching's prize model and water-ballast tank; and although the form and material of Francis's iron boat were unsuited to such fittings, I urged that if air-casks were substituted for the air-boxes and air-compartments in bow and stern, she would be a more safe and serviceable boat than the prize model. Notwithstanding this, the iron boat was abandoned, and another of Mr. Beeching's boats ordered by the Shipwrecked Fishermen's Life Boat Committee for the Rhyl station.

In order to carry out one of the objects of the society, "to exhibit an improved construction of fishermen's boat," and practically to test the usefulness of the principles and alterations I advocated, I designed a boat in which the properties of a life-boat could be applied to the fishing boats in use on our coast, without impairing their utility for the purposes of each locality, or much increasing their cost. In March, 1852, the boat was building at Liverpool, and I took for her type the life-boats of that port, the fishing boats of the Shetlands, and the north country cobble, so as to obtain a light draught of water and facilities in landing on a beach.

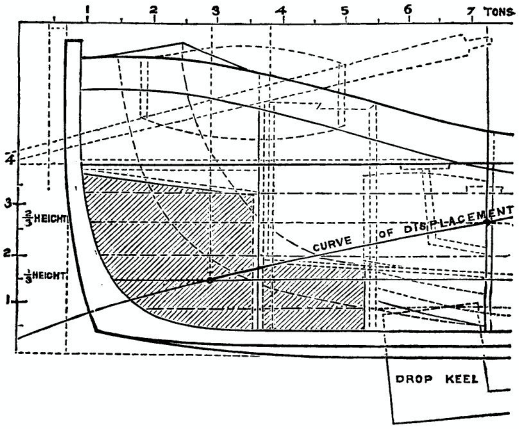
Her dimensions are—length, 28 feet; breadth, 7 feet; depth, 3 feet 6 inches; shear of gunwale, 26 inches; external bulk to gunwale, 568 cubic feet; displacement when loaded to two-thirds of her depth, 7¼ tons. Clinch built of larch planks, on eight-angle-iron frames, having bulk-heads athwart the boat to one-third of the depth. The annexed diagrams show this, and also exhibits the form and outside planking, angle-iron bilge, and false keel with iron drop or sliding keel, and also the internal fittings of platform over bulk-head, wells, and tanks, the latter one-third the breadth and one-fourth the depth amidships. The diagrams also show the disposition of extra buoyancy of fishermen's cork life-buoys in bilge, and the position of the air-casks under the thwarts with self-acting valves to relieve the water to the level of flotation, and pumps to discharge the water below.

The peculiarities of construction are the substitution for numerous small timbers of seven or more angle-iron frames, with bulk-heads one-third the depth, which gives strength, and divides the length into water-tight compartments admitting fore and aft partitions. These divide the breadth of the boat into side-bilge, and bottom compartments, the latter only being water-tight, with two water ballast tanks of 29 cubic feet amidships, one-third the breadth at bottom, and one-fourth at top, as shown in diagram. When empty, they would have an extra buoyancy of 16 cwt. While full it would act as water-ballast, or be used as a fish-well by fishing boats. Three smaller open wells collect the water, the centre one containing two relieving valves and two pumps, that clear both boat and ballast-tanks of water.

EXPERIMENTAL FISHERMAN'S LIFE-BOAT, BUILT AT LIVERPOOL.—MIDSHIP SECTION, SCALE ½-INCH TO A FOOT.



SHEAR PLAN OF STERN OF FISHERMAN'S LIFE-BOAT.—SCALE ¼-INCH TO A FOOT.



Self-righting power may be attained by four air-casks secured above the thwarts in bow and stern, weighing 50lbs. each, and displacing 30 cubic feet or 17 cwt. of water, when the boat is turned over by the sea. The annexed sheer plan of stern of boat exhibits the disposition of air-casks and iron false keel above and below the water-line, which, when the boat is bottom up, displaces half the weight of the boat before the gunwale is immersed, and, counterbalanced by the ballast, causes the boat to right herself.

The boat was launched in October, 1850, and weighed 27½ cwt. Light draught of water 8½ inches, and with 33 men on board, 15¼ inches, and these standing all on one side brought her gunwale down. As a *life-boat*, the extra buoyancy of the hull is half a ton, the air compartments and wells 61 cubic feet, movable buoyancy 24 pair of fishermen's cork buoys in bilge, and 10 air-casks at sides or under thwarts, 38 cubic feet, weighing 4½ cwt., giving an effective buoyancy of 3½ tons, when filled by the sea up to thwarts, sufficient to carry 40 men and to right herself. This was proved by repeated trials at Liverpool and Birkenhead, either with or without water-ballast.

By the self-acting valves, the boat relieved herself of water to the level of flotation in 1½ minutes without water-ballast, drawing 16 inches, and with water-ballast freed herself in one minute drawing 18 inches.

The pumps in pump well, and buckets in bow and stern well, clear the water below, thus attaining the two principal requirements for the prize offered by the Duke of Northumberland, viz, self-righting power and freeing herself of water.

As to the other two points, that the present boats "are too heavy" and "are very expensive." The weight of hull, 27½ cwt., before mentioned, was increased by the movable buoyancy of cork in bilge, air casks and stores, with the addition of 3 cwt. to the angle iron false keel and sliding keel, bringing the total weight of the boat to 36 cwt., or about 1·28 cwt. per foot in length.

The best criterion of relative efficiency, weight, and cost of life-boats obtainable, is a comparison with the result of the costly alterations made in the Percy life-boat at Woolwich in 1852, and in the life-boats since built by the National Life-Boat Institution on the design and under the superintendance of Mr. James Peake, the naval architect of Woolwich Dock-yard. The efficiency of these boats having been tested at several stations by Commander Ward, R.N., the inspector of life-boats to the National Institution, we may feel assured that all that could be effected by science in design and seamanship in practical trial, will have been obtained in the last of the seventeen boats built during the last three years.

The recent annual report of the National Institution, published in their Life Boat Journal of May, 1855, contains a statement of the 50 life-boats now maintained by them on our coasts, giving the dimensions, weight, cost, builder, and number of lives saved by each boat.

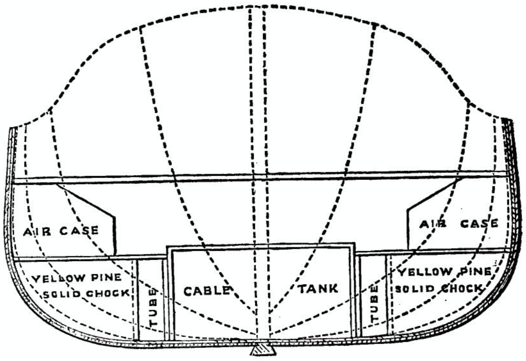
Taking the Cullercoats boat first built at Woolwich, and altered during 1852, and the eight boats of the latest construction, the average dimensions of the nine are: length 28⅓rd feet, breadth 7½ feet, ratio of length to breadth 3·75, weighing 40¾ cwt., or an average of 1·43 cwt. per foot in length. My "Fisherman's Life Boat" is 28 feet long, ratio of length to breadth 4·00, thus closely approximating to the average of the nine, whilst the weight is only 36 cwt. It may be here stated that repeated trials by Mr. Peake and myself rendered it necessary in each case to make a gradual increase in the weight of the iron keel—the latest boats by Mr. Peake having one of cast iron of 9 cwt., while in the Fisherman's Life Boat, by the use of angle-iron false keel, the object is attained at half the weight, by the position of the iron drop-keel, as shown in diagram 3, besides its advantage under sail and safely in a heavy sea or beaching, to which I shall more especially allude subsequently.

The average cost of the last eight boats built on Mr. Peake's design, by Forrest, of Limehouse, is £149 each, or five guineas per foot in length. The cost of the Cullercoats boat, built at Woolwich, is not mentioned, but must have been very considerable, seeing that she was altered both in proportion, form, and fittings, several times, sent to the coast by Her Majesty's steamers, and tried by the coast guard officers before being sent to her station, by which time her cost must have been increased three or four fold. With my "Fisherman's Life Boat," the cost of the first boat has likewise greatly exceeded what they may be ultimately constructed for, which I estimate at £100, or between £3 and £4 per foot, fitted for fishing. The alterations in the "Fisherman's Life Boat" were confined to the internal fittings, and like the Woolwich boat, arose out of the difficulty of keeping the air compartments under the platform water-tight, and from the cork placed under it becoming soaked with wet and losing its buoyancy, and thus preventing the boat retaining her efficiency.

Whatever the extra expense may have been to the Government, the Institution, the Shipwrecked Fisherman's Society, or myself, it will have been a judicious outlay, if the practical experience obtained results in an improved construction of the life-boats stationed on our coasts, or making the existing fisherman's boats to have the properties of a life-boat.

The result of Mr. Peake's experiments is shown by his last boat being four times as long as she is broad, with a flat floor and straight sides, but fine lines in bow and stern, with a considerable sheer of gunwale. The planking is of diagonal pine, and there is a water-tight platform or deck, one-third the depth, resting on four stout pine bulkheads athwart the boat, secured to bottom to form air-tight compartments in bow and stern, the bilge spaces being filled with blocks of light pine, instead of cork or boxes, as heretofore. In the midship part of the platform is a covered well, containing anchor, cable, and stores, with air boxes at the sides under the thwarts, and air compartments in bow and stern up to height of gunwale. These assist in giving the power of "self-righting," and are aided by a thick cast iron false keel, bolted to keel bottom and keelson, and weighing about 1 cwt. to every 3 feet of length. The boat frees itself of water by six tubes through the bottom fitted with self-acting relieving valves at the height of the platform. She is fitted to steer with oars, and to pull 8 to 12 oars double banked, to carry a small lug sail, and is provided with improved life belts, waterproof coats and boots, and everything requisite for the special service of a life-boat at most of the stations on our coasts.

MR. JAMES PEATE'S LIFE-BOAT.



Thus it will be seen that the repeated experiments of Mr Peake and myself have led to the adoption by both of a model very similar in its details, the only difference being, that whereas Mr. Peake's is intended for a coast life-boat only, useful for no other purposes, mine is for giving to a fisherman's boat the properties of a life-boat when requisite.

With this view, the "Fisherman's Life Boat" is fully rigged with a lug foresail and mizen, similar to the numerous fishing boats on the coast of Cornwall and many of the Scotch and Shetland boats, the masts being stepped in three moveable trunks, as used by Chinese fishing boats, so as to alter the rake to suit the action of the sails when going free or on a wind, these being used as a standing lug in tacking, the sails having battens similar to the Chinese sails, to keep them to their masts and facilitate reefing. Like the east-coast luggers, they are intended to carry a mainsail in fair weather, the trunk being fitted with a winch to work the gear, trawl, or lines; there are also two wells for live fish of 30 cubic feet below the water-line amidships, with openings through the keel, as shewn on section. The cork used for nets may be stowed in the bilge under the platform as buoyancy or ballast.

To test this rig and fittings, the boat was placed at the disposal of four fishermen experienced in the estuary off the Mersey and the Dee, and employed in trawling off Hoylake, in company with numerous fishing boats, which were made shorter and of greater breadth, drawing two to three feet more water, having three to five tons of stone ballast. On trial, the "Life Boat" held good way with the fishing boats while dragging the trawl, but when beating to windward, the deep keel fishing boats were more weatherly, and the fishermen stated that the life-boat was too buoyant or floaty, and that there was difficulty in keeping the fish wells water tight.

To obviate these objections, the bulk heads and partitions of wells were secured to bottom, the angle iron false keel and drop keel being substituted for the flat false keel, increasing the weight 3 cwt. These have been found to answer the purpose intended, the boat retaining her self-righting power, while at the same time the sliding keel makes her more weatherly and stiff when down, and admits of the boat being sailed into shoal water. She was allowed to take the ground on a rocky bottom without injury in a close reef breeze.

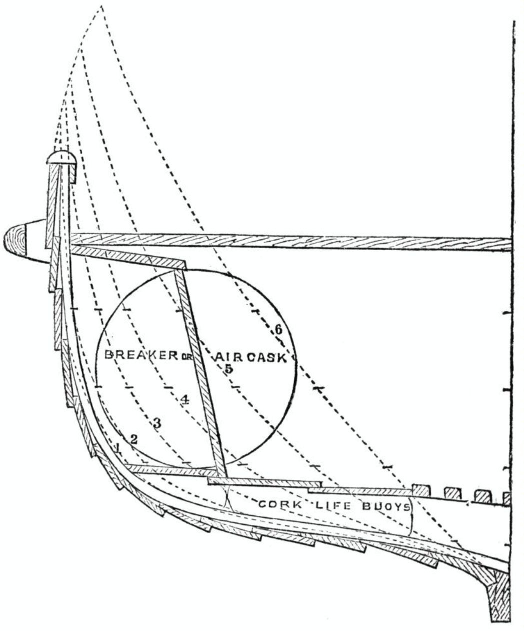
The advantages of this, both to fishing and life-boats, was exemplified last year by the unfortunate loss of one of the crew of the Liverpool life-boat, near Formby, who had gone out fishing in one of these small over-ballasted boats with his son, and was obliged to attempt to land on a sandbank, the boat drawing so much water when she took the ground, that the sea turned her over and drowned the crew. *With the sliding keel up*, the "Fisherman's Life-Boat" would have taken the ground in about two feet of water, where the sea would hardly have depth to turn the boat over or prevent the crew landing. *With the sliding keel down*, the "Fisherman's Life-Boat" would have crossed Rhyl bar, under sail, without upsetting, as Beeching's Prize Life Boat did, on the 22nd of January, 1853, by rolling over to windward and remaining bottom up till six of the crew were drowned.

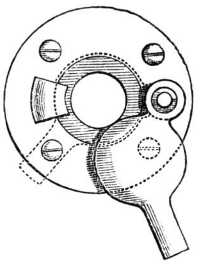
From investigation on the spot, and from the survivors, the upsetting is clearly traceable to the weight of water above the platform, and water ballast below moving to windward with the roll. This destroyed the stability and overcame the buoyancy, as it had before done in so many trials of Beeching's boats. The principle of this latter is now condemned by the alteration of nearly all the boats he has built for the Duke of Northumberland, Ramsgate, and the "Shipwrecked Fishermen's Mariner's Society," who ordered this boat for the Rhyl station in preference to accepting my offer to place at their disposal my Fisherman's Life-Boat.

The magnitude of our mercantile marine, the great increase in the size of our ships, the number of steamers, and our numerous seagoing population, make the exhibition of an improved construction of "ship's life-boat" a great desideratum. Following in the steps of my respected friend, the late George Palmer, Esq., I have designed a plan and specification of a ship's life-boat, with a view to apply the properties of a life-boat to the ship's boats in ordinary use at sea. Bearing in mind the necessity of their being light and strong, and the fittings such as can be easily repaired or removed without increasing the cost of the usual boats, I have designed her to be built of light pine, clench built, on eight angle iron frames, rivetted to an angle-iron keel on stem and stern plate, also to an angle-iron stringer under the thwarts, and an angle-iron gunwale piece. Bulkheads of pine are rivetted athwart the frames, one-fourth the depth from keel and one-eighth the breadth under the thwarts. The disposition of planking and internal fittings are shewn in the annexed diagram of the main breadth section of a medium-sized boat, 28 feet long, 7 feet broad, and 3 feet 6 inches deep, having 10° rise of floor, with the bilge a little hollow near the keel; the sheer of gunwale half an inch to a foot; the water lines hollow forward and straight aft; eight thwarts, 3 feet 6 inches apart.

The buoyancy is comprised in side compartments, between a rising plank fore and aft under the thwarts (between the bulkheads, 1-8th of the breadth broad) and a fore and aft platform over the bulkhead at the bilge; the bow and stern partitions to be made up by a side plank, as shown on the section, between midship thwarts to be filled by 6 air casks or water-breakers; the bilge below the platform to be filled with cork, the boat to be hung to the davits by threefold iron blocks, hooked to a shackle in the stem and stern, as shown in sheer plan, where will be shown the position of the air compartments in bow and stern. The weight of this boat is calculated at one ton, and it will displace about five tons, and when filled to the level of thwarts with water will have buoyancy sufficient to carry thirty men.

SHIP'S LIFE-BOAT.





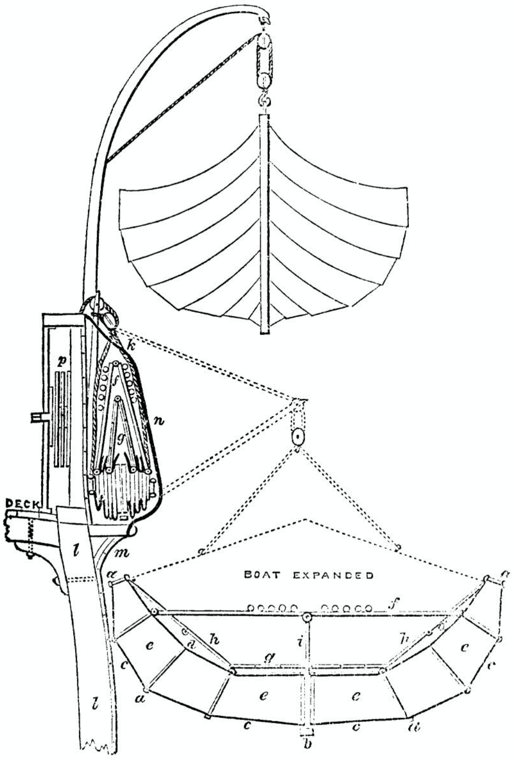
The small diagram shows a zinc plug, of simple construction, intended to be screwed to the bottom plank, where the usual cork or wooden plug is placed; but as the former gets lost, and the latter often splits the plank, the zinc plug closes by turning a flat ridge over the faced collar or hole, secured in its place by screw and nut.

The cost of this plug is 1s. 6d., and I am assured the boats can be built for 18s. to 24s. a foot, by the boat builders usually employed in building ships' boats on a plan and specification which have been lithographed and distributed, in the hope of inducing shipowners to make trial of such a combination of wood and iron as will give the greatest strength with the least weight.

Lowering Ship's Boat.—With respect to this very important question, after much experience I am convinced that the mode adopted by whalers is the simplest and best. That mode consists in strong davits, a good purchase of two large threefold blocks, with swivel hooks, into a shackle at the top of the stem and stern post. The boat to hang, as will be seen in the annexed diagram of a ship's side, with the usual iron davits and quarter-boats.

Our large steamers, transports, and emigrant ships, might carry a sufficient number of these boats at davits, with the addition of a collapsing life-boat stowed outside the bulwark, with separate davits, as shown in the diagram annexed, as would enable them to be provided with the means of saving all on board in case of wreck or fire, and of disembarking all the troops she could carry.

CONVEYING LIFE-BOATS AT DAVITS.



BERTHON'S COLLAPSING BOAT.

The Rev. J. S. Berthon, of Fareham, having for years devoted much time, labour, and money in the perfection of his invention, the following brief description is offered in explanation of the diagram of his collapsing life-boat, for providing abundant boat accommodation to all sea-going ships:—

The frame work, which is made of wood, with bands and fastenings of metal, is composed of longitudinal timbers running the whole length, and hinged at their ends to each other, and to the top of the stern and stern-post. They are broad and deep, and extend two skins of a very strong flexible waterproof material, the outer skin being firmly attached to their outer edges, and the inner one to their inner edges. The whole body of the boat is thus divided into as many water-tight longitudinal compartment as there are spaces (usually eight) between the timbers. These air-cells fill themselves with air in the act of expansion. Her mode of hanging is shown in the annexed diagram.

The extension of this boat, which is instantaneous, when its weight is allowed to fall upon certain slings or spans attached to its gunwales, requires no exertion of manual strength, and it is kept permanently open by the thwarts, bottom boards, and certain gunwale stanchions.

The space required to stow these boats (viz., outside the ship's bulwarks with strong strappings) is about one-sixth of their width when open, so that numerous boats can thus be carried out board in constant readiness, and when in action they are inferior to none in buoyancy, safety, general efficiency as life-boats, and speed under sail or oars. The cost is about the same as that of the best ship's life-boats.

These boats have been most favourably reported on by the officers of H. M. dockyard at Portsmouth, by order of the Admiralty, and some large pinnaces on this principle now built for the Government will be shortly under trial in the Royal Navy.

Richardson's Patent Tubular Life Boat.—In reference to this boat, I think I cannot do greater justice to the public than by quoting from the remarks upon it by General Chesney, and read by him before the British Association at Hull, in 1853. The general states of the tubular as follows:—" The boat is formed of two tubes of tinned iron, forty feet in length by two and a half in diameter, tapering at either end and meeting each other, thus giving the appearance of sheer. An iron framework, securely rivetted, unites the whole into one mass, the tubes having longitudinal bars of iron and hoops within, and iron keels running from end to end; they are divided into water-tight compartments, occupied by air-proof bags; a cork fender surrounding the whole fabric. The rowers and passengers are placed on a platform above the framework, which is surrounded by a light gunwale the height of the rowlocks. A rope passes along under the kelson, for the purpose of towing. Sliding keels are added, to render her more weatherly. She carries two lug-sails, top-sails, and jib, steers, rows, and sails well. She was launched January, 1852."

The claims of the tubular life-boat do not by any means rest upon speculation or opinion, however sound, for those who are disposed to examine this interesting question at more length will find ample proofs of her capabilities in rowing, sailing, and steering, &c., as detailed in "The Cruise of the Challenger Life Boat from Liverpool to London," published by Pickering.

The gallant anthor of this communication has always taken a deep interest in life-boats, and has individually been the means of saving life on several occasions; once on the coast of Ireland he swam of to a wreck with a line carried between his teeth, and succeeded in establishing communication with the shore, thus saving the lives of *thirty persons*, at a time when a storm was raging. According to an arrangement made at Hull, a further paper on "Life Boats" was read by General Chesney, at Liverpool, at the last meeting of the British Association, and it was in consequence of that paper and another on a sister subject by myself, that the general committee recommended "that General Chesney and Mr. Henderson be a committee for the purpose of collecting the statistics of the design, arrangement, and dimensions of life-boats." I therefore take this opportunity to beg the transmission of any facts on this subject, either as respects the efficiency or management of life-boats to General Chesney or myself.

Finding no encouragement in this country, the "Challenger" was sold in October last to the Humane Society at Oporto. A tubular boat has since been ordered by the National Life Boat Institution for Rhyl, on the application of the local committee there, and many others are applied for.

Parratt's Tubular Life Raft.—This raft is shortly reported on by the assistant to the Surveyor of the Navy, Blue Book, No. 332, 1854, as simple in its construction and possessing great buoyancy, and suitable for emigrant and troop ships.

The last journal of the "National Life-Boat Institution" contains the annual report of the Committee, and notices several important matters affecting the general position of life-boats and their management. Among these are—1st. The recommendation by the Committee that in future the Institution should be denominated the "Royal National Life-Boat Institution." 2nd. The transfer made to the Institution of nine life-boats, eight boat houses, and five life-boat carriages, from the Shipwrecked Fishermen's and Mariners' Royal Benevolent Society, and the relinquishment by that Society altogether of its life-boat establishment. In connection with this, the Committee notice that "a large outlay will be required to make alterations and improvements in some of the boats which the Committee consider advisable." 3rd. The Committee allude to the pecuniary aid which will in future be afforded to the Institution by the Board of Trade. The *manner* in which this aid will be afforded will be by repayments to the Institution, to a limited amount, of—

1st. Award to the crews of its life-boats, or others, for saving or endeavouring to save life.

2nd. Payments to its life-boat crews, for a quarterly exercise and trial of their boats.

3rd. The salaries of the coxswains of its life-boats.

4th. The hire of horses, steam tugs, or other means (when necessary) for transporting life-boats to the localities of wrecks.

5th. The payment of persons for assisting to launch and haul up life-boats.

On these conditions the Institution undertakes, from its own resources, supplied by voluntary contributions, to provide and maintain at each of its stations a life-boat of the best description, and amply furnished with everything necessary to make it efficient. To carry out these benevolent designs the amount of income for the past year was, from donations and dividends, £1,744 19s. 4d., whilst the expenditure being £3,672 15s. 4d., the difference could only be provided for by a sale of stock to the amount of £1,927 16s.

Now there are on the coast of England about 100 life-boat stations, 50 of which are at present under the above Institution, and of the remainder the most efficient are at Liverpool, Shields, and other large shipping ports, whilst the rest are various in their efficiency and management—some being in places where it is difficult to obtain efficient crews to man them, whilst some of them have boats which the local fishermen will not use. Of the 50 under the Institution there are only 17 of the improved model, 9 of Palmer's, 14 of the old models, 7 of Beeching's, and 4 of Costain's, White's, and Clarkson's.

These facts, in connection with the very great expenditure of the institution, the aid offered by the Board of Trade from the mercantile marine funds, and the necessity of being guided by local circumstances, have led me to the conclusion that, to provide efficiently and nationally for the preservation of life from shipwreck, there should be attached to each coast-guard station a life-boat of Mr. Peake's design, provided and paid for by the Admiralty, and kept under the management of the coast guard officers, or of the recently-embodied sea fencibles, so that both may be exercised in this as well as their other duties.

This would not in any way interfere with my proposals to place, wherever local circumstances and the development of fisheries permitted it, an improved construction of fisherman's boat, and the application to some of the properties of a life-boat, in the manner described in the "Fisherman's Life-boat." The expenses attending this should most properly be borne by the Board of Trade, the payments being made either to the "Royal National Life-boat Institution," as proposed, or to the "Shipwrecked Fisherman's and Mariner's Royal Benevolent Society," one of the purposes for which it was incorporated being "to exhibit an improved construction of fisherman's boats."

I may here mention that one of the first objects of this Society was, as its name imports, to assist fishermen on the coast, and a majority of the original subscribers were fishermen, who received assistance to replace nets and boats lost, as well as to relieve the widows and children of those who might lose their lives in their calling. The life-boat department of the Society, now handed over to the "Royal National Life-Boat Institution," originated in the melancholy loss of several Shetland fishing-boats, in 1848, when, the crews perishing, many widows and children were left to be provided for at great expense by the Society. This induced the feeling that, as prevention is better than cure, the former could be best attained by improving fishermen's boats.

This object has been gradually lost sight of, many of these subscribers now being seamen and marines of the Royal Navy, and the management being exclusively in the hands of naval officers. After the Society was incorporated, besides the regular subscription of 2s. 6d. per annum, many gave a further sum of 3d. to the life-boat fund, the capital of which was nearly all expended in 1854 on the nine boats lately handed over to the National Life-Boat Institution. This had become necessary from the untoward circumstance of the adoption of Beeching's prize model by the Life-boat Committee of the Society; and, as a necessary consequence, costly alterations were required, and from want of confidence, very little good has been done by organising crews, which should have been one of the most important duties of the Society.

As the National Life-boat Institution and Board of Trade are now providing crews for coast-boats, the Shipwrecked Fishermen and Mariners' Society should devote its funds to the improved construction of fishermen's boats as well as to the efficiency of ships' life-boats and the means of lowering them. They would then, by the former, carry one object of their incorporation as to their fishermen subscribers, and, by the latter, would also be doing their duty to their numerous seamen subscribers, for the loss of any of whom, it must be borne in mind, that the Society have to pay from £3 to £5 to their widows and children.

With the fearful loss of life, both of fishermen and from merchantmen, a great duty devolves both on the Government and also on any society connected with the subject. One thing necessary is, that further information should be diffused, by drawings and specifications of tried boats, so that any party wishing to build may be able to choose the boat which, from his own observation, he may know to have acted efficiently, and I have placed for this purpose in the hands of the secretary full drawings and specifications of a fisherman's life-boat and ship's life-boat, for the use of any who may require them.

As has been suggested by Lord Hardwicke, it would be a most desirable thing were a committee of this and other scientific societies formed, for the purpose of investigating the merits of these as well as other designs, the practical experiment of which might very well be carried out by a committee of the British Association, at the meeting in Glasgow, in August. As a step towards these experimental trials, it may be stated that General Chesney and myself have been appointed by the general committee of that body to report on the statistics of life-boats generally, and there would be no difficulty in making the necessary arrangements for trial in the Clyde, should this proposition be met in the spirit with which it is made.

PARLIAMENTARY REPORTS.

SESSIONAL PRINTED PAPERS.

Par. No.

Delivered on 19th and 21st of May, 1855.

207. Savings Banks—Accounts.
236. Cambridge University—Copies of Communications.

237. Bills of Exchange Bill, &c.—Report from Committee.
238. Freight Money (Greenwich Hospital)—Return.
241. West India Islands Relief—Statement.
242. East India (Sattarah)—Return.
252. Victoria-street Sewer—Return.
222. Merchant Seamen's Fund—Account (a corrected Copy).
128. Bills—Bills of Lading.
130. Bills—Absconding Debtors (Ireland).
131. Bills—Fisheries (British Islands and France).
132. Bills—Personal Estates of Intestates (amended).
134. Bills—New South Wales Government.
135. Bills—Waste Lands (Australia) Acts Repeal.
136. Bills—Railways (Ireland).
138. Bills—Militia (No. 2) (amended).
140. Bills—Brighton Incorporation.
129. Bills—Bankruptcy (Ireland).
Criminal Offenders (Ireland)—Tables.
Public Works (Ireland)—Tables.
Agricultural Statistics (England)—Report of Poor Law Commissioners.

Delivered on 22nd May, 1855.

228. Loan Societies—Abstract of Accounts.
254. Assessments (Metropolis)—Return.
246. Foreign Sugar—Account.
249. County Treasurers (Ireland)—Account.
250. Constabulary (Ireland)—Copy of Instructions.
137. Bill—Grand Juries.

Delivered on 23rd and 24th of May, 1855.

239. Burial Grounds (Metropolis)—Return.
247. Army before Sebastopol—4th Report from the Committee.
96. Bills—Grants of Land.
123. Bills—Formation, &c., of Parishes.
133. Bills—Grand Jury Assessments (Ireland).
139. Bills—Places of Religious Worship Registration (amended).
141. Bills—Edinburgh Lands (as amended by the Select Committee).
143. Bills—Personal Estates of Intestates (as amended in Committee, and on consideration of Bill, as amended).
144. Bills—Militia (No. 2,) as amended in Committee, and on consideration of Bill, as amended).
146. Bills—Bills of Lading (No. 2).

Delivered on 25th of May, 1855.

145. Bill—Truck Act Amendment.

MEETINGS FOR THE ENSUING WEEK.

Mon. Royal Inst., 2. General Monthly Meeting.
Architects, 8. Rev. J. L. Petit, "A few Remarks on Italian Architecture.
Entomological, 8.
Chemical, 8.
Tues. Horticultural, 3.
Royal Inst. 3. Dr. Tyndall, "On Voltaic Electricity."
Linnæan, 8.
Wed. Ethnological, 8½.
Pharmaceutical, 8.
Thurs. Royal Inst. 3. Mr. G. Scharf, jun., "On Christian Art."
Antiquaries, 8.
Photographical, 8.
Fri. Astronomical, 8.
Philological, 8.
Royal Inst., 8½. Prof. Faraday, "On Richenkorff's Indication Apparatus."
Sat. Royal Botanic, 3¾.

PATENT LAW AMENDMENT ACT, 1852.

APPLICATIONS FOR PATENTS AND PROTECTION ALLOWED.

[*From Gazette, May 25th*, 1855.]

Dated 19th January, 1855.

148. P. A. le Comte de Fontaine Moreau, 4, South-street, Finsbury—Electro motive power. (A communication.)

Dated 18th April, 1855.

860. H. Harvey, 73, Denbigh-street, Pimlico—Application of cork for beds, mattrasses, &c.

Dated 25th April, 1855.

919. H. Cockcroft, Haslingden—Self-registering letter box.

Dated 2nd May, 1855.

982. Sir J. S. Lillie, 4, South-street, Finsbury—Tents.

Dated 5th May, 1855.

1003. J. Beaumont, Elland—Treating wheat meal.
1005. J. H. Dickson, Rotherhithe—Scutching and heckling machinery.
1007. S. Roberts, Hull—Steam engines.

Dated 7th May, 1855.

1009. R. Broadbent, Stalybridge, and S. Farron and B. Grundy, Ashton—Steam engines.
1011. Marquis de Balestrino, Genoa—Motive power by explosive gases. (A communication.)
1013. E. Price, Cardiff—Daylight reflectors.
1015. R. Clark, Glasgow—Elastic finish to piece goods.
1017. T. Bazley, Manchester—Creels.
1019. J. H. Johnson, 47, Lincoln's-inn-fields—Hair pins. (A communication.)
1021. J. H. Johnson, 47, Lincoln's-inn-fields—Cocks and valves. (A communication.)

Dated 8th May, 1855.

1023. W. B. Wilton, Lowestoft—Steam-engine furnaces.
1024. C. C. E. Minié, Paris—Muskets.
1025. J. Hughes, Chapel-en-le-Frith—Paper.
1026. D. Foxwell, Manchester—Sewing machines.
1027. T. T. Lingard, Manchester—Presses.
1028. R. Needham, Hollinwood—Steam boilers.
1029. J. H. Johnson, 47, Lincoln's-inn-fields—Paper tubes. (A communication.)
1030. J. A. Williams, Baydon—Machinery for driving ploughs, &c.
1031. J. Bowron, South Shields—Glass tiles.
1032. B. Hallewell, Leeds—Drying grain.
1033. H. V. Newton, 66, Chancery-lane—Air engine. (A communication.)
1034. J. J. Imbs, Brumath, France—Cartridges. (A communication.)
1035. T. Williams, 14, Red Lion-street, Clerkenwell, and J. H. Fuller, New Brentford—Wrenches, pliers, and spanners.

Dated 9th May, 1855.

1036. R. K. Bowley, Charing-cross—Boots and shoes.
1037. J. Gedge, 4, Wellington-street South—Cleansing rooms. (A communication.)
1038. J. Gedge, 4, Wellington-street South—Woven fabrics. (A communication.)
1039. J. Gedge, 4, Wellington-street South—Spectacle cases. (A communication.)
1040. E., H., and F. C. Cockey, Frome—Clod crushers.
1041. J. M. Worrall, Salford—Cutting piled goods.
1042. J. M. Worrall, Salford—Cutting piled goods.
1043. R. S. Markindale, Salford—Removing wool from sheepskins.
1044. D. Morrison, Birmingham—Metallic bedsteads, sofas, &c.
1045. G. Taylor, Liverpool—Steam-engine governors. (A communication.)
1047. C. Whipple, United States—Preparing and combing wool.
1048. S. Grainicher, Zofingen—Pumps. (A communication.)

Dated 10th May, 1855.

1049. C. Mertens, Gheel, Belgium—Breaking and scutching machinery.
1050. J. W. Lewis, Manchester—Lightning conductors.
1051. E. A. Forbush, Ashland, U.S.—Sewing machine.
1052. W. Scott and A. Powell, Birmingham—Rifling and draw-boring gun barrels and ordnance.
1053. A. V. Newton, 66, Chancery-lane—Preparing colours for printing fabrics. (A communication.)
1054. M. Allen, Worship-street—Valve.
1055. E. Eastwood, Long Eaton—Railway carriages.
1056. F. W. Norton, Edinburgh—Figured pile fabrics.
1057. J. Harris, Darlington, and T. Summerson, West Auckland—Iron railway wheels.
1058. C. J. Hunt, Mitcham—Tug and other hooks.

Dated 11th May, 1855.

1059. J. Hallam, Sheffield, and J. Elee, Manchester—Rowels or toothed cylinders for self-acting temples.
1060. E. and T. Humphries, Pershore—Riddles for separating straw from grain.
1062. J. H. Johnson, 47, Lincoln's-inn-fields—Sulphuric acid. (A communication.)
1063. C. Henderson, Tufnell park—Locks.
1064. J. Pascall, Chislehurst, and G. Fry, Lee—Blanching, forcing, and propagating garden pots.
1065. J. Steele, Greenock—Drainage of moulded sugar.

Dated 12th May, 1855.

1069. F. G. Sanders, Poole—Brick, pipe, and tile machines.
1070. G. Robinson, Manchester—Invalid's bed.
1071. J. Herdman, Belfast—Wrought-iron plates for shipbuilding, &c
1072. W. B. Adams, 1, Adam-street, Adelphi—Propulsion of vessels.
1074. G. Whyatt, Openshaw—Cutting piled goods.
1075. J. H. Linsey, Coleman-street—Account books.
1076. P. A. le Comte de Fontaine Moreau, 4, South-street, Finsbury—Stone-boring machinery. (A communication.)
1077. F. J. Picton, Wignehies, France—Knitting machinery.
1078. W. Dray, Swan-lane—Frames for structures.
1079. F. A. Theroulde, Paris—Preserving animal substances. (A communication.)
1080. T. Rickett, Stony Stratford—Pressure gauges.
1081. J. Dupre, Plymouth—Ovens. (A communication.)

Dated 14th May, 1855.

1082. J. Higgins, Oldham—Steam boilers.
1083. W. Robertson, Edinburgh—Treatment of fuel.
1084. J. Pettigrue, Drumcree—Propelling vessels.
1085. R. Mc Connell, Glasgow—Girders.
1086. R. Morrison, Newcastle-on Tyne—Steam engines.
1087. J. Buchanan, Glasgow—Healds for weaving. (Partly a communication.)
1088. T. C. Eastwood and T. Whitley, Bradford—Preparing and combing wool.
1089. J. Mason, S. Thornton, and L. Kaberry, Rochdale—Spinning machinery.
1090. A. Robertson, Sheffield—Fire-grates.
1091. R. S. Newall, Gateshead—Laying down submarine electric telegraph wires.
1092. H. C. Garrett, Massachusetts—Lubricating axles.
1093. L. L. Hill, Westhill, New York—Silvering glass.
1094. J. Lackmann, Hamburgh—Sheet iron. (A communication.)
1095. G. T. Bousfield, 8, Sussex-place, Loughborough-road—Burning hydro-carbons in lamps. (A communication.)

Dated 15th May, 1855.

1096. P. Christie, Greenock—Tent.
1098. W., and F. B. Fawcett, and J. Lamb, Kidderminster—Carpets.